CLAIMS

What is claimed is:

1. A method for utilizing a plurality of transmitters to determine one or more location characteristics of a body, said plurality of transmitters producing a plurality of RF carrier signals, said method comprising:

mounting one or more distributed antennas to said body, each of said one or more distributed antennas having a non-unique phase center;

receiving said plurality of RF carrier signals from said plurality of transmitters with said one or more distributed antennas; and

determining said one or more location characteristics of said body.

2. The method of Claim 1, wherein said step of determining further comprises utilizing carrier phase measurements for determining said one or more characteristics of said body.

3. The method of Claim 1, wherein said one or more location characteristics comprises a position of said body.

4. The method of Claim 1, wherein said one or more location characteristics comprises an attitude of said body.

5. The method of Claim 1, wherein each of said one or more distributed antennas has a substantially spherical coverage.

6. The method of Claim 1, wherein at least a portion of a view of said one or more transmitters by said one or distributed antennas is blocked by said body.

7. The method of Claim 6, further comprising providing that each of said one or more distributed antennas are circularly constructed with a respective physical origin.

8. The method of Claim 7, further comprising determining a vector from said respective physical origin to a phase center for each of said plurality of transmitters.

9. The method of Claim 1, further comprising determining a distance between each of said plurality of transmitters and each of a plurality of phase centers whereby each phase center corresponds to one of said plurality of transmitters.

10. The method of Claim 1, further comprising obtaining a coarse estimate of a position of said body, and utilizing said coarse estimate for determining a unit vector related to a first position vector of a physical center of said distributed antenna with respect to a reference system and a second position vector between said body and a respective of said plurality of satellites.

11. The method of Claim 10, further comprising utilizing said unit vector for obtaining an improved estimate of a position of said body, and utilizing said improved estimate for iteratively determining said unit vector more accurately.

12. The method of Claim 1, further comprising determining information related to a phase center constellation comprised of a plurality of phase centers such that each phase center in said phase center constellation is related to a respective of said plurality of transmitters.

13. The method of Claim 12, further comprising determining a plurality of vector magnitudes whereby each vector magnitude is related to a vector from a physical center of said distributed antenna to one of said plurality of phase centers.

14. A method for utilizing a plurality of transmitters in a plurality of locations to determine one or more location characteristics of a body, said method comprising:

mounting one or more distributed antennas to said body, each of said one or more distributed antennas having a plurality of phase centers with respect to said plurality of locations of said plurality of transmitters; and

determining one or more values related to said plurality of phase centers.

15. The method of Claim 14, further comprising:

determining one or more values related to a vector to a reference center of said body with respect to a fixed coordinate system.

16. The method of Claim 15, further comprising:

determining one or more values related to a position vector from said reference center to an i^{th} satellite.

17. The method of Claim 16, further comprising:

determining one or more values related to a vector from said reference center to a

phase center related to said i^{th} satellite.

18. The method of Claim 17, further comprising:

determining an attitude vector for said body.

19. The method of Claim 16, further comprising:

determining a unit vector for said body from said reference center with respect to an i^{th} satellite.

20. The method of Claim 16, further comprising:

estimating a unit vector by obtaining an estimate of said position vector.

21. The method of Claim 20, further comprising:

reducing the error of said estimate of said unit vector by iteration.

22. The method of Claim 14, further comprising:

measuring a carrier phase from an i^{th} satellite, and adding a correction to said measured carrier phase.

23. The method of Claim 22, wherein said correction is determined utilizing a known attitude of said body.

24. The method of Claim 22, wherein said correction is determined by making an approximation of said position vector.

25. A system for determining location characteristics of a body utilizing a plurality of spaced apart transmitters, said system comprising:

one or more antennas mounted to said body, each of said one or more antennas having a non-unique phase center with respect to said plurality of spaced apart transmitters, said one or more antennas providing a wide angle coverage for maintaining contact with said one or more spaced apart transmitters; and

means for determining said location characteristics in response to reception of signals from said spaced apart transmitters by said one or more antennas.

26. The system of Claim 25, wherein said means for determining said location characteristics comprises utilizing one or more equations related to calculating a carrier phase.

27. The system of Claim 25, wherein said means for determining said location characteristics utilizes the following equation:

$$\|v_i\|^2 = \|r_{si} - r_B\|^2 + \|r_{pi}\|^2 - 2\|r_{pi}\|\|r_{si} - r_B\|\cos(\beta_i)$$

where

$$\cos(\beta_i) = \sin(\alpha_i) = \sqrt{1 - \left[\frac{(r_{si} - r_B) \bullet \hat{z}_B}{\|r_{si} - r_B\|}\right]^2}$$

and

$$\hat{z}_B = \sin(\theta_B)[\hat{x}_e \cos(\phi_B) + \hat{y}_e \sin(\phi_B)] + \hat{z}_e \cos(\theta_B)$$

28. The system of Claim 25, wherein said means for determining said location characteristics utilizes the following equation:

$$\|v_i\| = \|r_{si} - r_B\| - r_{pi} \bullet \frac{r_{si} - r_B}{\|r_{si} - r_B\|}$$

29. The system of Claim 25, wherein said means for determining said location characteristics utilizes the following equation:

$$\|v_i\| = \|r_{si} - r_b\| - \|r_{pi}\| \cos(\beta_i)$$

30. The system of Claim 25, wherein said means for determining said location characteristics utilizes the following equation:

$$\hat{\tilde{r}}_{sib} \approx \frac{r_{si} - \tilde{r}_b}{\|r_{si} - \tilde{r}_b\|}$$

31. The system of Claim 25, wherein said means for determining said location characteristics utilizes the following equation:

$$\Delta = k\|r_{pi}\|\sin(\xi)$$

32. The system of Claim 25, wherein said means for determining said location characteristics utilizes the following equation:

$$\Delta_j = \alpha_0 + k\|r_{pi}\|\sin(\xi), j = 1,\ldots,N$$

33. A radiator system for determining location characteristics of a body utilizing a plurality of spaced apart transmitters, said body having a curved surface, said radiator system comprising:

one or more radiators mounted to said curved surface of said body so as to conform to said curved surface, each of said one or more radiators having a non-unique phase center with respect to said plurality of spaced apart transmitters, said one or more antennas providing a wide angle coverage for maintaining contact with said one or more spaced apart transmitters.

34. The radiator system of Claim 33, wherein said one or more radiators comprises a circular ring.

35. The radiator system of Claim 33, wherein said one or more radiators comprises a plurality of circular rings.

36. The radiator system of Claim 33, further comprising means for determining said location characteristics in response to reception of signals from said spaced apart transmitters by said one or more antennas.

37. The radiator system of Claim 33, wherein said means for determining said location characteristics comprises utilizing one or more equations related to a carrier phase.

38. The radiator system of Claim 33, further comprising means for determining an attitude of said body utilizing no more than two antennas wherein said body has three attitude degrees of freedom.

39. The radiator system of Claim 33, further comprising means for determining an attitude of said body utilizing no more than one antenna wherein said body has two attitude degrees of freedom.

40. The radiator system of Claim 33, wherein said one or more radiators maintain contact with said plurality of spaced apart transmitters even when a portion of a view of said one or more antennas to said plurality of spaced apart transmitters is blocked.

41. A method for carrier phase determination of location characteristics utilizing a plurality of spaced apart transmitters, comprising:

mounting one or more antennas to a moveable body positioned among said plurality of spaced apart transmitters such that said antennas maintain contact with each of said plurality of spaced apart antennas as said attitude of said body changes without utilizing RF switches; and

determining one or more values related to one or phase centers of said one or more antennas.

42. The method of Claim 41, further comprising determining an attitude solution for said body when said body has three attitude degrees of freedom utilizing no more than two antennas.

43. The method of Claim 41, further comprising determining an attitude solution for said body when said body has two attitude degrees of freedom utilizing no more than one antenna.

44. The method of Claim 41, further comprising providing that said one or more antennas has wide angle coverage for simultaneous contact with said plurality of spaced apart transmitters.